The Pulsed Flow Algorithm (PFA) Applied to Coupled Respiratory and Circulatory Systems A. STAPLES, E. ORAN, J. BORIS, C. KAPLAN, K. KAILASANATH, Naval Research Laboratory — The Pulsed Flow Equations (PFE) are a set of coupled partial differential equations designed to capture features particularly relevant to internal flows through flexible elastic channels, such as flows in physiological systems in biological organisms, and hydraulics systems. The equations are an extension of the standard one-dimensional fluid flow equations that, in addition, are able to capture two-dimensional diffusion, branching, transport, viscous, and other effects. A limiting case of the equations is the standard one-dimensional fluid flow equations. The equations are discretized and solved partially using an asymptotic solution, after which they reduce to tridiagonal form. The solution formalism can be applied to many types of complex networks of internal flows, and solves these problems, including some important two-dimensional effects, at the cost of a one-dimensional tridiagonal computation. Here we apply the PFA to describe a coupled circulatory and respiratory system calibrated to the average human body.

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